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## **MANAGING FLEXIBILITY IN CONSTRUCTION PROJECTS**

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### **ABSTRACT**

*Traditionally, construction projects have been managed using the network based planning and scheduling tools, such as PERT / CPM and their derivatives. While these tools are reliable and useful when the project scope of work and the environment of execution are relatively stable, several difficulties are encountered when the underlying assumptions of network based models are no longer valid in context. Studies of success factors in several construction projects emphasize several environmental factors. One of the factors that can determine the successful outcome of a project execution is flexibility in managing the project. The present paper highlights some of the issues involved and the utility of a flexible approach in managing such construction projects in practice.*

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*Keywords: Flexibility, Construction, Project, Planning, Scheduling tools*

### **Introduction**

The traditional approach to managing projects in general and construction projects in particular is dominated by tools and techniques based on the classical PERT / CPM models that are now over five decades old. The literature on these models is quite vast, and a variety of models are available to suit specific situations. These models are characterized by a rigid set of assumptions related mostly to the activity durations, precedence relationships and resource requirements. While these models are useful in understanding the complicated relationships within a project they are often of little use in managing projects when the assumptions are no longer valid in the context. While several studies of critical success factors have emphasized the use of network based planning and scheduling techniques, some studies have also indicated that the use of such techniques is not a sufficient cause for project success. Many authors have recommended the need for "room to maneuver" in order to bring about successful completion of such projects. In a way, we find that "flexibility" in project execution can be an important determinant of project success. However, the running debate on the usefulness of rigidity versus flexibility in managing projects is far from over. Rigidity in schedule specifications and constant monitoring and adherence to original plan offers its own charm of predictability. At the same time, unrealistic assumptions can create severe problems in execution and can even erode credibility of management. The project manager thus has to address two fundamental issues: (1) whether the current project needs to be managed using a rigid approach or a flexible approach, and (2) what would be the right balance of rigidity and flexibility, and under what conditions, the manager should opt for flexibility. This paper discusses the strategic application of flexibility as a useful tool for managing complex construction projects.

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### **Limitations of Network Based methods**

Success of a project is closely related to the adoption of best practices in project management. Several researchers have conducted studies of factors that contribute to success of a project. In a project management benchmarking study of Fortune 500 companies, Toney and Powers [1997] identified and grouped the key success factors into three areas: (1) project strategies (e.g. communications), (2) project management professionalism (e.g. compensation), and (3) standardized methodologies and procedures (e.g. project and people management). In a study of project management best practices in the UK construction industry, Jawahernes and Price [1997] found that 'preparing and organizing' and 'developing project definition' were among the highest ranked tasks. In their study of American project managers, Zimmerer and Yasin [1998] reported that the highest rated characteristics for effective project managers and for project success were team building, communicating, demonstrating trust and focusing on results. In his study of new products development, Cooper [1998] concludes that best practices do not emerge from vacuum, rather the organization culture must value and nurture best practices.

In a study of project management practices in Canada, Loo [2002] reported that the top best project management practices included technical as well as people themes. The technical themes include: integrated Project Management System (PMS), effective scope management, effective project planning, scheduling and controlling, and effective contract management. The people-related themes include: high caliber project teams, stakeholder participation, effective communications within teams and externally, and customer satisfaction. It is thus seen from these studies that the network based project management approach is not an undisputed factor leading to project success.

### **Importance of Managing Flexibility**

The importance of managing flexibility in projects has been pointed out by several researchers. When a project environment changes (from what it was at the time of planning), project owners (or users) desire to have "room to maneuver" to be able to adjust projects as they gain knowledge about their needs and changes in the project context (Midler[1995]). Kreiner[1995] reports that flexibility is necessary to face the changes and uncertainty in the business environment. On the contrary, several studies suggest that flexibility is not desirable, and a clear project definition is a critical success factor for projects (Miller and Lessard [2000]). In between the two extremes of rigidity and flexibility, researchers like Olsson [2006] point out that a structured approach is needed to manage flexibility in a project and flexibility is usually not desired in the late phases of the projects to ensure the efficiency of project execution.

Sager [1990] suggests flexibility as one approach to prepare for the effects of uncertainty in planning. Kreiner [1995] points out that the traditional focus on stability in project management becomes challenged under uncertainty, creating 'drifting environments'. Drifting environment may occur not necessarily by actual changes in the project context but also when project stakeholders get a better understanding of their actual needs and improved ability to express the needs. Flexibility can also be seen as a response to environmental uncertainty (Karlsen [1998]) reported in Olsson [2006]. Amram and Kulatilaka [1999] compare flexibility to owning an option- the right, but not the obligation to take an action in future. This can increase the value of a project as long as flexibility is preserved and resources are not irreversibly committed.

### **Measures of Flexibility**

Husby et al. [1999] define project flexibility as "the capability to adjust the project to prospective consequences of uncertain circumstances within the context of project". Mandelbaum and Buzacott [1990] propose a measure of project flexibility as the number of remaining alternatives

after a decision has been taken. Similarly Midler [1995] and Eikeland [2001] discuss project flexibility related to “room for manoeuvring”. This is made up by future yet undetermined internal decisions, and may also be seen as a measurement of internal uncertainty of project. According to Eikeland [2001] quoted in Olsson [2006], a decision is within the room for maneuvering if it does not violate the consequences of previous decisions. Husby et al. [1999] define project flexibility as “the capability to adjust the project to prospective consequences of uncertain circumstances within the context of project”.

### **Strategies for Managing Flexibility**

According to Olsson [2006], flexibility in the decision making process may be achieved by using following three strategies:

1. “late locking” of project concepts, specifications and organizations (Miller and Lessard [2000] refer to “late locking” as an exploring iterative front end process and as a key success criterion for large engineering projects). Once the projects are locked, they are executed in a traditional way,
2. Continuous step-by-step locking of the project by a successive commitment to projects, and
3. Contingency planning, where a base plan is defined, but also a set of alternative plans that can be activated if needed.

According to Chapman and Ward [1997], contingency plans reflect anticipated potential departures from the defined plan for a project. They point out that it is important to restrict the development of contingency plans in order to reduce planning cost.

Olsson [2006] finds that flexibility in the decision process and the product may interact for any given project. From a project management point of view, it makes a major difference if the flexibility lies in the product or the decision process. Different strategies for project flexibility management are identified in Fig. 1, each characterized by high or low flexibility in the process and product, respectively.

As indicated in Fig.1, the situation with low flexibility in both the product and the decision process assumes stable environment. This means that the project concepts and management of the project are not designed for adjustment within the project timeframe.

If there is high flexibility in product and low in the process, the strategy is called “robust concept”. This situation assumes that the decision process related to the project can be relatively straightforward because result of the project is prepared for alternate use. However, flexibility in a product comes at a price. Therefore, it can be seen as a waste of resources if flexibility in the product is not needed at a later stage. The situation with low flexibility in product and high flexibility in the process indicates that final decision can be postponed (for example, the freezing of specifications) in order to gain as much knowledge as possible. When flexibility in a product is costly, low flexibility in product is desirable. This leads to late or continuous locking, and contingency planning. “Flow” has been used to describe the situation with high flexibility in both the product and process. It contains many of the aspects of high flexibility in either the product or process.

High		
Flexibility in the product	Robust concepts	Flow
	Stable Environment	Late or continuous locking, Contingency planning
Low	Flexibility in the process	High

Figure 1: Flexibility in the product and decision process(Olsson[2006])

### Flexibility through Modular Design

Olsson[2006] states that the degree of modularity also provides flexibility in the projects. Modularity refers to the possibility of dividing the project into more or less independent sub-units. Modularity can enable projects to cope with uncertainty because individual components do not have a critical role (Miller and Lessard [2000]). Projects such as IT-system development and road improvement have assumed high level of modularity. However, major “one piece” projects such as bridges and tunnels have a low level of modularity, based on the “we do not build half a bridge”- approach (Olsson [2006]).

### Flexibility at Different Stages of Project

Flexibility can also be examined from the point of view of project phase (Olsson [2006]). In this view, flexibility can exist in three different phases of project: front-end, planning, and execution. The flexibility is normally seen as desirable in front-end phase of the projects while it is undesirable in the execution phases of the projects. Morris and Hough [1991] warn against changes in projects once the specifications have been established. Miller and Lessard [2000] point out the irreversibility of large engineering projects and the importance of bold commitment from key stakeholders. They also suggest that there should be no flexibility once the front-end phase is over.

Olsson [2004] points out that flexibility is primarily an approach to improve effectiveness of projects rather than efficiency. Flexibility may adversely affect the delivery of project in time and within budget. Efficiency is linked to the immediate outcome of the project and is a question of doing things right and producing project outputs in terms of the agreed scope, quality, cost and time and is an internal measure. Effectiveness is linked to the longer term effects of the project, or to do the right things. Eikeland [2001] relates effectiveness to show how the results of a project contribute to value added for owners and users. According to Samset[2003], effectiveness concerns the extent to which the project’s tactical objective (or the goals) can be achieved. A project with sufficient flexibility to utilize opportunities to increase the value for owners and users might in the end prove to be more effective (Kreiner [1995]).

A common tool for achieving flexibility in projects is the use of option based contracts, which enable a continuous locking of the projects. Mahmoud –Jouini et al [2004] discuss time management in projects. They point out that a key factor in creating win-win situations between

stakeholders in Engineering, Procurement and Construction (EPC) contracts lies in flexibility of contracts and the implicit relations that are created by the contracts.

**Flexibility in Managing Changes to Project Scope**

Scope changes are a key driver to cost overruns of projects. Scope changes are generally seen as undesirable from a project and contractor perspective, even though contractors can see changes as a possibility to improve profits from the projects (Christensen and Gordon [1998]). A typical scope change may arise because the users or project owner wants to increase the effectiveness of the project.

According to Dvir and Lechler [2004], changes in both plans and goals of projects typically reduce both the efficiency and customer satisfaction of engineering projects. The scope change cost is low in the front-end phase of the projects and becomes higher and higher as time goes by. Two different strategies can be chosen to manage scope changes: (a) to avoid scope changes and (b) to reduce the negative impact from scope changes. In Fig. 1, flexibility strategy is to achieve flexibility without creating scope changes in the project. In this way, scope changes are avoided or reduced by the use of late locking of projects and by not taking decisions until one really has to.

**Stakeholder Opinions on Project Flexibility**

Key stakeholders directly linked to the most projects are: project owners, users, project management and contractors. In a study on flexibility on projects, Olsson [2006] reported that different stakeholders have different perspectives of project flexibility. Olsson [2006] mentions that project owners and users are likely to be more positive towards changes aimed at increased effectiveness while stakeholder such as project management and contractors are less likely to accept changes.

	Front-end	Planning	Execution
Owner	+	+	+
Users	+/-	+	+
Project Management	+	+/-	-
Contractor	N/A	-	-

+ = Positive opinion on project flexibility, - = Negative opinion, +/- = Mixed opinion

**Figure 2: Stakeholders’ opinion on flexibility in different project phases (Olsson [2006]).**

Fig. 2 gives a summary of the observed opinion on flexibility as seen in a time perspective. Owners of the projects appear to be clear in their support of flexibility, and contractors in their dislike. On the other hand, users and project management have different needs for flexibility in different project phases. As long as the funding model for a project means that the users have nothing to lose from demanding changes and extensions, they have an incentive to push for changes. The user group as a stakeholder is more often connected to the quality and usability of the final product and has less direct contact with the projects.

According to Kreiner [1995], project owner is made guardian of relevance and thereby the project’s effectiveness while the project manager is made the guardian of efficiency. In the case where project management is part of the same organization as the owner, project management is more likely to be positive to flexibility as compared to the case where project management has a weaker organizational connection to the project owner.

### Behavioral Aspects of Flexibility

During their study, Olsson [2006] observed that if flexibility was prepared for, it will be used. It will often be used even when it is not prepared for. Changes and extensions were found in most of the projects, in spite of the well-known risk for cost overruns in such cases. Projects that were not planned for flexibility in the decision process were found to have used flexible approaches anyway. This indicates that if there is a possibility for flexibility in a project, it will probably be utilized.

Flexibility in the front-end phase is the least controversial part of project flexibility. After the front-end phase, flexibility in well-defined parts of the projects can be managed without much reduction in efficiency. To manage flexibility, it is beneficial to identify critical part of projects where flexibility is needed. In the next step, appropriate strategies for project flexibility of the identified areas are chosen. The observed tendency for users to advocate flexibility in late phases of projects indicates that projects with a high user influence should have a higher need for an active approach to project flexibility than other projects.

### Conclusions

In this paper, we examined different aspects of flexibility in project management practices. It is seen that best practices in project management activities and processes encompasses several areas such as project planning, scope management, communications and client/ stakeholder participation and so on. Flexibility is an important aspect to be considered in managing projects. The opinion on flexibility by different stakeholders appears to be related to the incentives faced by the stakeholders. The stakeholders such as project management and contractors have to adapt to the flexibility requirements of the client (or user). Flexibility like scope changes, late locking etc. usually disturbs efficiency of the organized work-flow and causes delays or rework. Therefore, managers and contractors often look negatively at flexibility. However, in general, flexibility has a value for the stakeholders who benefit from changes and late locking of the projects and it is a cost for those who have to adapt to these changes. Thus, the project owners and users who have incentives related to achieving the project's purpose prefer flexibility.

### References

- Amram M and Kulatilaka N, 1999, *Real Options: Managing strategic investment in an uncertain world. Financial Management association survey and synthesis series*. Boston: Harvard Business School Press.
- Chapman C and Ward S, 1997, *Project risk management. Processes techniques and insights*, West Sussex, UK: Wiley.
- Christensen DS and Gordon JA, 1998, Does a rubber baseline guarantee cost overruns on defence acquisition contracts?, *Project Management Journal*, 29(3): 43-51.
- Cooper R, 1998, Benchmarking new product performance: results of the best practices study, *European Management Journal*, 16(1): 1-17.
- Dvir D and Lechler T. 2004, *Plans are nothing, changing plans is everything: the impact of changes on project success*, Res Policy, 33: 1-15.
- Eikeland PT, 2001, Teoretisk analyse av byggeprosessen, Samspill i byggeprosessen, prosjektnr.10602 (Title in English: Theoretical analysis of the construction process).
- Husby O, Kilde HS, Klakegg OJ, Torp O, Berntsen SR, Samset K, 1999, Uncertainty as benefit- Managing project uncertainty: possibility, risk, decision, action., *Norwegian Centre for Project Management, Norwegian University, Report No. NTNU 99006*.
- Jawaharnesan L and Price ADF, 1997, Assessment of the role of the client's representative for quality improvement, *Total Quality Management*, 8(16):375-89.
- Karlsen JT, 1998, *Mestring av omgivelsesusikkerhet*, Ph.D. thesis, The Norwegian University of Science and Technology.

### *Managing Flexibility in Construction Projects*

- Kreiner K, 1995, In search of relevance: project management in drifting environments, *Scandinavian Journal of Management*, 11(4): 335-46.
- Loo, Robert, 2002, Working towards best practices in project management: A Canadian Study, *International Journal of Project Management*, 20: 93-98.
- Mahmoud-Jouini SB, Midler C and Garel G, 2004, Time-to-market vs. Time-to-delivery managing speed in engineering, procurement and construction projects, *International Journal of Project Management*, 22(5):359-67.
- Mandelbaum M and Buzacott J, 1990, Flexibility in decision making, *European Journal of Operations Research*,44: 17-27.
- Midler C,1995, Projectification of firm, the Renault case, *Scandinavian Journal of Management*, 11(4):363-75.
- Miller R and Lessard D,2000, *The strategic management of large engineering projects, shaping institutions, risk and governance*, USA: MIT.
- Morris PWG and Hough GH,1991, *The anatomy of major projects, A study of the reality of project management*, Chichester,UK: Wiley.
- Olsson NOE, 2004, Flexibility in engineering projects: blessing or curse? Paper presented at the NORDNET 2004: International PM conference, Helsinki, Finland.
- Olsson NOE, 2006, Management of flexibility in projects, *International Journal of Project Management*, 24: 66-74.
- Sager T, 1990, *Notions of flexibility in planning related literature*, Nordic Institute for studies in urban and regional planning.
- Samset K, 2003, *Project evaluation: making investment succeed. Trondheim* : Tapir Academic Press.
- Toney F and Powers R,1997, *Best practices of project management groups in large organizations*, Upper Darby, Pennsylvania: Project Management Institute.
- Zimmerer TW and Yasin MM, 1998, A leadership profile of American project managers, *Project Management Journal*, 29(1): 31-38.